EX PARTE OR LATE FILED

National Audubon Society

1901 Pennsylvania Avenue, NW
Suite 1100
Washington, DC 20006-3405
(202) 861-2242
(202) 861-4290 *fax*

RECEIVED

APR 16 1998

FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

DOCKET FILE COPY ORIGINAL

RECEIVED
APR 15 3 04 PM '98

April 14, 1998

Office of the Secretary
Federal Communications Commission
Washington, DC 20554

Mr. William Kennard, Chairman
Federal Communications Commission
1919 M Street, N.W. Room 814
Washington, D.C. 20554

Ex Parte Letter Re: FCC [redacted] No. 97-296 and MM Docket No. 97[redacted]182

Dear Chairman Kennard:

The National Audubon Society is hereby submitting comments regarding the Federal Communications Commission's Notice of Proposed Rule Making in the Matter of Preemption of State and Local Zoning and Land Use Restrictions on the Siting, Placement, and Construction of Broadcast Station Transmission Facilities (the Proposed Rule). Our view is that, pursuant to Federal law, the Proposed Rule will have a significant impact on the environment, and therefore requires the FCC to prepare an Environmental Impact Statement.

Actions Requiring an EIS

The National Environmental Policy Act, 42 U.S.C.. 4321 et seq. (NEPA), requires the Commission and all other federal agencies to conduct an Environmental Impact Statement (EIS) for *all major federal actions significantly affecting the quality of the human environment.* Moreover, the Commission's regulations at 47 CFR §1.1307(a) require thorough environmental analysis of any action that may affect a listed species or may lead to construction in wetlands. The NEPA requirements supersede all other Commission rules that may be inconsistent with NEPA. 47 C.F.R. 1.1303. The term "action" encompasses rules and regulations such as the Proposed Rule.

The Proposed Rule is a Major Action Significantly Affecting the Quality of the Human Environment

Under NEPA, the determination of what constitutes a major action significantly affecting the environment is to be made on a case by case basis, judging both the context and intensity of the particular proposal. The impacts to be examined include ecological, aesthetic, historic, cultural, economic, social or health impacts. In addition, there are three types of effects that must be examined:

1. *Direct effects*, which are caused by the action and occur at the same time and place;
2. *Indirect effects*, which are caused by the action and are later in time or farther removed in distance but are still reasonably foreseeable; indirect effects "may include . . . effects on air and water natural systems, including ecosystems," 40 C.F.R. 1508.8; and
3. *Cumulative effects*, which result from the incremental impact of the action when added to other past, present, and reasonable foreseeable future actions. 40 C.F.R. 1508.7.

Effects include ecological effects, such as the effects on resources and on the components, structures, and functioning of affected ecosystems. 40 C.F.R. 1508.8. The Proposed Rule is a major action with significant direct, indirect and cumulative effects.

No. of Copies rec'd 0+1
List ABCDE

Printed on recycled paper

Direct and Indirect Effects.

By exempting construction of hundreds of broadcast towers from state and local law and review, the Proposed Rule would result in the construction of towers without regard to ecological, aesthetic, historic, cultural, economic, social or health impacts, many of which are regulated only by state and local law. Since these state and local laws were originally passed to address significant public concerns, it is clear that waiving them will have a significant impact on the environment. This is especially true in the case of the construction of towers under the Proposed Rule. Many of these broadcast towers are more than one thousand feet high, and some reach heights of two thousand feet or more. Many towers are located in or near wetland areas, streams, and other protected areas. Other towers are located or planned to be located at the tops of mountains, many in remote and sensitive areas. Conducting a federal NEPA review of this proposed federal action would allow the FCC to determine whether the exemption of so many different sites from state and local environmental review would have environmental impacts and consequences that could reasonably be avoided.

In addition to many other ecological, aesthetic, historic, cultural, economic, social or health impacts, the construction of the towers without regard to local and state regulations will significantly impact populations of migratory birds, many of which are in decline, and some of which are threatened or endangered.

It is estimated that between 2 million and 4 million migratory birds are killed each year as a result of collisions with TV and radio towers. It is well-documented that higher levels of bird mortality result when these towers are sited on high ground in the four major migratory flyways. Red safety lights often used on towers have been found to attract flocks of migrating birds, leading to increased bird injury and mortality.[1] For example, a 38-year study of a single television tower in west central Wisconsin documented the deaths of 121,560 birds representing 123 species, primarily long-distance neotropical migrants.[2] Many species of neotropical migratory birds are experiencing steep population declines and the siting of numerous new broadcast towers in migration corridors could greatly exacerbate this problem. (*See* attached chart of documented bird kills and representative studies, also attached hereto).

Cumulative Effects.

Cumulative effects are defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonable foreseeable future actions, regardless of what agency (federal or non-federal) or person undertakes such actions. 40 C.F.R. 1508.7. The Proposed Rule will have significant cumulative impacts when combined with siting and construction of each tower, which by themselves will be major actions. "[W]hen deciding the potential significance of a single proposed action (i.e., whether to prepare an EIS at all), a broader analysis of cumulative impacts is required. The regulations clearly mandate consideration of the impacts from actions that are not yet proposals and from actions – past, present, or future – that are not themselves subject to the requirements of NEPA." Fritofson v. Alexander, 772 F.2d 1225, 1242-3 (5th Cir. 1985).

The Proposed Rule must be the subject of an EIS which considers not only the cumulative effects of the Proposed Rule and the siting and construction of towers, but also the cumulative actions. In Fritofson v. Alexander, supra, the court noted that scoping regulations require connected, cumulative, and similar actions to be considered together in the same EIS. In other words, the EIS must address not just the action of adopting the Proposed Rule and waiving state and local law, but also the foreseeable actions of siting and constructing towers. In addition, the EIS must address not only the effects of the Proposed Rule and siting and constructing of towers, but it must also address the cumulative effects of all of these actions.

---

[1] TV Towers Take Deadly Toll on Night-Migrating Birds, Buffalo News, October 6, 1996, 1C; Mysterious Flights, Under Cover of Night, Chicago Tribune, November 3, 1985, F14.

[2] C. Kemper, A Study of Bird Mortality at a West Central Wisconsin TV Tower from 1957-1995, The Passenger Pigeon, Vol. 58, No. 3, 1996.

Courts have previously established guidelines for the incorporation of cumulative effects on migratory species into NEPA decisionmaking. Natural Resources Defense Council, Inc. v. Hodel, 865 F.2d 288 (D.C. Cir. 1988).

In the case of bird mortality, for example, it is easy to see how the cumulative effects could be synergistic, that is, where net adverse cumulative effect is greater than the sum of the individual effects. If one tower is built, and 10,000 birds of one species are killed, it may not be enough to effect the long term health of that species' population, over more than one year. On the other hand, 30,000 or 40,000 deaths may result in a population crash with respect to that species.

Other Applicable Federal Law

In addition to NEPA requirements, the federal government has significant responsibility for the conservation of migratory birds and their habitats under four *migratory bird treaties* (with Mexico, Canada, Japan, and the former Soviet Union) that would be undermined by the Proposed Rule. The four treaties cover numerous species of neotropical migratory birds, many of which are experiencing steep declines in populations due in some part to collisions with tall structures in migratory flyways, including broadcast towers.[3] In line with the federal government's treaty obligations for the protection of migratory birds, current FCC policy calls for locating broadcast towers outside of migratory bird flyways wherever possible.[4]

Moreover, before the Commission can resolve to issue the Proposed Rule, it must consult with the USFWS to ensure that the proposed rule will not harm any threatened and endangered species. Section §7(d) of the *Endangered Species Act* requires consultation whenever a federal action may affect a protected species. Threatened and endangered migratory birds are among those that suffer from collisions with broadcast towers. Thus, in addition to preparing an EIS, the Commission must consult with USFWS before proceeding with the proposed rule.

We believe that your proposed rule will exacerbate this problem by removing necessary avenues of environmental oversight that could otherwise lead to more environmentally sound siting decisions for broadcast towers. State and local laws that govern the siting and operation of broadcast towers help avert or reduce these impacts. By preempting these laws, the proposed rule would ensure that construction and operation of broadcast towers will cause significantly greater harm than state and local laws currently permit.

Thank you for your consideration of these comments. When the Commission decides to move ahead with the EIS, please add us to the public comment list so that we may submit comments on the draft EIS.

Sincerely,

Daniel P. Beard

Daniel P. Beard
Senior Vice-President for Public Policy

---

[3] See, e.g., WatchList, an annual roster of birds that are in serious decline. Compiled by scientists from Partners in Flight member organizations, which include the National Audubon Society and the United States Fish & Wildlife Service, the WatchList targets bird species with at-risk populations. Threats to these species include habitat degradation, development, and collisions with structures.

[4] In the Matter of Implementation of the National Environmental Policy Act of 1969, 49 F.C.C.2d 1313.

Cc: Commissioner Harold Furchtgott-Roth
Commissioner Gloria Tristani
Commissioner Susan Ness
Commissioner Michael Powell

File Copy ~~309~~ 310

Reprinted from AMERICAN BIRDS, November 1978, Vol. 32, No. 6, pp. 1114–1121
Published by THE NATIONAL AUDUBON SOCIETY
Printed in U. S. A.

The Composition and Seasonal Variation of Bird Losses at a Tall Tower in Southeastern North Dakota

Michael L. Avery, Paul F. Springer, and J. Frank Cassel

Introduction

NUMEROUS REPORTS OF BIRD MORTALITY at towers have been published in the past 20 years. The most extensive studies have been those of Stoddard and Norris (1967) and Crawford (1974) near Tallahassee, Florida, and Laskey (1956 – 1969b) and her associates in Nashville, Tennessee. Although the mass mortality of birds at towers is regrettable, it does provide investigators with much otherwise unobtainable information concerning nocturnal migration. Tordoff and Mengel (1956) were the first to make extensive use of this source of data to obtain information on sex, age, weight, molt, and other characteristics of the migrants. Until means are developed to prevent bird losses at towers, it is urged that greater use be made of this otherwise wasted source of study material.

The 366-m transmitting tower of the U.S. Coast Guard's Omega Navigation Station in southeastern North Dakota was completed in September 1971. Because of concern by some conservationists over the possible effects of this structure on birds, particularly waterfowl, migrating through the James River Valley, a study was conducted from September 1971 through November 1973 to record and evaluate the extent of losses and seasonal variation in the composition of the kill at the Omega tower.

Methods

Description of Tower Site

THE OMEGA NAVIGATION STATION is about 1.5 km west of the James River and 3.0 km west of LaMoure. The tower is situated in a marshy area that includes some grassy upland. A complete description of the site and the tower has been published elsewhere (Avery *et al.* 1976, 1977).

Sampling Plan

SINCE THE MARSHY NATURE of much of the habitat made it impossible to effectively search the entire area (168 ha) under the extensive transmitting cables and guy wires for dead birds, a sampling plan was devised (Fig. 1). The plan was based in part upon findings of previous studies of mortality at towers which indicated that most dead birds are found within about 60 m of the central structure. Thus, the intensity of the sampling was greatest near the tower. The inner gravel area within 46 m of the tower was examined completely for birds. The three service roads were also included in this stratum (A) because it was felt that these roads, lying under the three sets of supporting guy wires, might receive a disproportionately greater number of dead birds than areas between the sets of guys.

Other strata (B, C, and D) were formed by concentric circles with radii of 92 m, 183 m, and 732 m, respectively. Two compass lines, one running north-south and the other east-west, divided these strata into 12 substrata beyond the central area. Two square sampling plots, 12.4 m on a side, were randomly located in each substratum. The 19 sampling plots in wet sites consisted of nylon netting suspended by steel frames 1.5 m high. The center of each net was anchored to the ground, and a wooden railing around the top at the perimeter of each net prevented birds from being blown out. The remaining five sampling plots were gravel surfaces on upland sites.

This initial sampling system was subsequently modified in spring 1972 when it was determined that the sampling intensity in the outermost stratum was not great enough to estimate accurately the kill in that stratum. Consequently, the entrance road beyond 183m was incorporated into the sampling plan in the outermost stratum. Although the road was not located randomly within the stratum, it did not lie directly beneath any of the transmitting cables or guy wires and, therefore, except for possible effects of prevailing winds, it was situated randomly with respect to the falling of dead birds. This modification increased the sampling area from 0.07 to 0.60 per cent in the stratum.

Searches for Dead and Injured Birds

EXCEPT FOR SEVEN DAYS, searches for tower casualties were made at dawn daily during four seasons: March 30 – June 4 and August 8 – November 15, 1972, and April 2 – June 2 and August 12 – November 3, 1973. In addition, searches were made on several days before and after each period of daily searches. Birds not found on sampling areas are included in the overall species list, but are not included in the projected kill estimates derived from the sampling plan (Table 1). In fall 1971, members of the staff of the Northern Prairie Wildlife Research Center conducted searches of the inner gravel area and roads two or three times weekly. These findings are included in Table 1, but no estimate of the total mortality for that season was possible because the sampling system was not in operation until spring 1972.

Removal of tower-killed birds by scavengers was assessed each season in 1972 and 1973 by placing tagged, dead birds on the inner gravel area, roads, and some of the 24 sampling sites. Usually, birds that were not taken overnight by scavengers were picked up in the morning during the search for tower casualties; however, some were left in place as long as 18 days before being removed by the investigator.

Surveys of Bird Inhabitants

IN ORDER TO DETERMINE the species frequenting the area, records were kept on the number of live birds seen in the marsh and upland within a distance of approximately 10 m

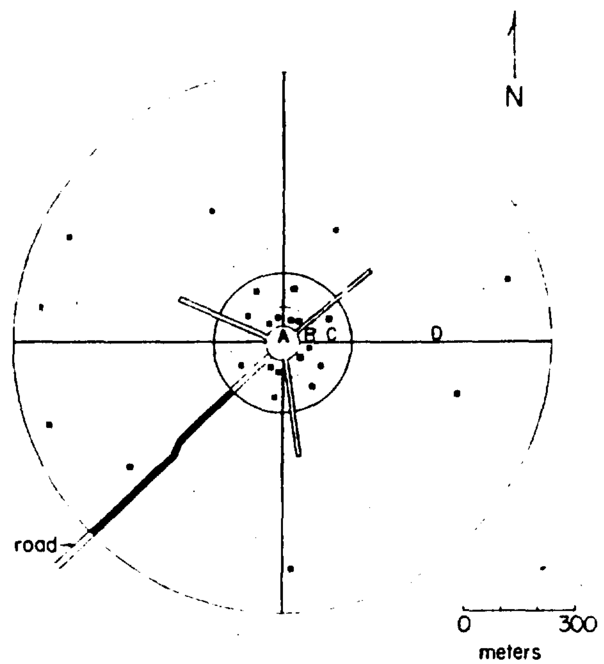

Figure 1 – Omega Navigation Station site showing sampling plan (road and sampling plots not drawn to scale)

Table 1 continued. Bird casualties and estimated mortality at the Omega tower, fall 1971 through fall 1973.

Species	*Fall 1971*	*Spring 1972*	*Fall 1972*	*Spring 1973*	*Fall 1973*	*Total*
Black-throated Green Warbler			1			1
Blackburnian Warbler	1				1	2
Bay-breasted Warbler			2			2
Blackpoll Warbler		2	2	1	3	8
Palm Warbler		3	9			12
Ovenbird	5	1	6		2	14
Northern Waterthrush	1	1	2	1	2	7
Mourning Warbler	15		6		5	26
Common Yellowthroat	3	16	8	5	5	37
Wilson's Warbler	10		4		6	20
Canada Warbler	3		1			4
American Redstart		2	2		1	5
Bobolink		3		1		4
Western Meadowlark		2		1	1	4
Yellow-headed Blackbird		7	1	2		10
Red-winged Blackbird	1	1	1	1		4
Orchard Oriole		1	1			2
Northern Oriole	2		1		3	6
Brown-headed Cowbird	1	4	2	1	2	10
Rose-breasted Grosbeak				1	1	2
Common Redpoll	1	2				3
Pine Siskin				1		1
Rufous-sided Towhee		1				1
Lark Bunting		2				2
Savannah Sparrow	8	22	10	6	8	54
Grasshopper Sparrow		21	3	3	1	28
Baird's Sparrow		2				2
Le Conte's Sparrow	2	16	3		3	24
Sharp-tailed Sparrow		1	1			2
Vesper Sparrow	1	3	2		3	9
Dark-eyed Junco		4	4	4	3	15
Tree Sparrow	5	8	7	3	5	28
Chipping Sparrow		4	1		2	7
Clay-colored Sparrow	2	20	7	2	26	57
Harris' Sparrow	4	2	3		3	12
White-crowned Sparrow		1			1	2
White-throated Sparrow	1	3	3	4	3	14
Fox Sparrow			1			1
Lincoln's Sparrow	6	4	4		12	26
Swamp Sparrow	1	1	3		3	8
Song Sparrow	1	4	2	1	1	9
Lapland Longspur	7	5	5	4	6	27
Smith's Longspur	1		1	1	1	4
Chestnut-collared Longspur					1	1
Unidentified	8	6	2	2	4	22
Total (102 species)	152	255	226	105	199	937
Number of birds found on sampling areas — Stratum A(1)[1]	—	131	142	54	110	437
B(16)	—	4	5	1	8	18
C(64)	—	1	5	3	3	12
D(165)	—	5	3	7	2	17
Estimated kill	—	1084	1037	1417	760	4298

[1] Expansion factor for each stratum is given in parentheses

sex composition, etc. The use of nets such as those described herein, effectively discourages mammalian scavengers, but may be less effective against owls or other avian predators and scavengers.

Seasonal Variation in Kill

THE COMPOSITION OF THE KILL varied considerably by season. Chi-square analysis showed that two families accounted for over half of the overall seasonal variation — warblers (44%) and vireos (11%). These birds were killed predominately in the fall. Wrens, icterids, and fringillids, all of which suffered greater spring than fall losses, each accounted for about 8 per cent of the total variation.

Table 2 shows that seasonal variation of losses was highly significant at the species level. Of the 26 most frequently killed species, mortality was proportionately higher for 6 in the spring and 8 in the fall. The remaining 12 species displayed no large seasonal differences in mortality, contributing less than 3.0 each to the overall x^2 value. Among the warblers and vireos, only the Common Yellowthroat incurred appreciably greater spring than fall losses, and among the fringillids, only the Lincoln's Sparrow suffered appreciably greater fall than spring losses.

The species in Table 2 that had proportionately greater spring than fall losses were observed commonly in the marsh and upland around the tower during the spring months and are common or locally common breeding birds in the southeastern part of the state (Stewart 1975). Stoddard

Table 2. Seasonal losses, by species, at the Omega tower.

Species[1]	Mortality Spring	Fall	Total	Contrib. to x^2
	2 seasons	3 seasons		
(S) Sora	24	22	46	3.46
(E) American Coot	9	17	26	0.16
(E) House Wren	7	6	13	1.29
(S) Long-b. Marsh Wren	11	3	14	9.51
(E) Swainson's Thrush	9	6	15	2.94
(F) Red-eyed Vireo	3	28	31	10.86
(E) Warbling Vireo	3	9	12	0.92
(E) Tennessee Warbler	7	5	12	2.00
(F) Orange-c. Warbler	2	22	24	9.21
(F) Yellow Warbler	5	55	60	23.02
(F) Yellow-rumped Warbler	1	19	20	9.47
(E) Palm Warbler	3	9	12	0.92
(F) Ovenbird	1	13	14	5.80
(F) Mourning Warbler	0	26	26	16.26
(S) Common Yellowthroat	21	16	37	5.23
(F) Wilson's Warbler	0	20	20	12.50
(S) Savannah Sparrow	28	26	54	4.09
(S) Grasshopper Sparrow	24	4	28	26.40
(S) Le Conte's Sparrow	16	8	24	8.06
(E) Dark-eyed Junco	8	7	15	1.40
(E) Tree Sparrow	11	17	28	0.01
(E) Clay-colored Sparrow	22	35	57	0.00
(E) Harris' Sparrow	2	10	12	2.41
(E) White-th. Sparrow	7	7	14	0.79
(F) Lincoln's Sparrow	4	22	26	5.85
(E) Lapland Longspur	9	18	27	0.30
	237	430	667	162.86
All other species	115	133	248	6.54
Total[2]	352	563	915	169.40

[1] (S) = greater spring losses, (F) = greater fall losses, (E) = approximately equal spring and fall losses.
[2] Does not include 22 unidentified birds.

and Norris (1967:71) noticed a similar relationship in their study: ". . . a relatively large spring kill seems more likely to pertain to species that breed abundantly with us . . . than to ones that travel farther north to their breeding ground." It would be interesting to know if this same pattern occurs elsewhere, but no other detailed reports of spring mortality at towers are known to us.

We hypothesize that migrants of locally breeding species are more selective in the spring than in the fall as to where they alight following a night's migration. As they descend in the early hours of the morning, birds whose characteristic nesting habitat resembles the area around the Omega station encounter a greater concentration of guy wires near the tower and suffer greater mortality than do species that breed in other habitats and remain at higher altitudes, not attracted to the marsh and grassy upland surrounding the tower.

Some mortality at the Omega tower may occur at dawn or dusk during local flights by resident birds. Depending on the extent of such activity, it, too, might help account for the abundance of locally breeding species in the spring kill. Throughout the study, birds observed flying in daylight hours near the Omega station avoided the guy wires and tower. However, it is conceivable that during times of poor visibility in the breeding season, birds engaging in aerial chases or flight displays occasionally strike guy wires.

THE SPECIES THAT EXHIBITED greater fall mortality (Table 2) were rarely seen in the vicinity of the tower at any time, and most do not breed commonly in the southeastern portion of the state (Stewart 1975). Exceptions were the Red-eyed Vireo (locally common) and Yellow Warbler (common). Of those species not differing greatly in their seasonal losses, only the American Coot and Clay-colored Sparrow were observed regularly at the tower site. They were common in 1972 when suitable habitat existed for them, but were seen only infrequently in 1973 when water levels were lower and brushy areas used by the sparrows were destroyed by grazing cows.

Seasonal variation in the species composition of tower kills has been noted by others (e.g., Caldwell and Wallace 1966, Stoddard and Norris 1967). In on each side of the path of the investigator during his daily searches for tower casualties. In addition, surveys of birds were conducted at least three mornings weekly in the James River Valley along 40 km of roads north and east of the tower site. Habitats surveyed included a semipermanent marsh, a permanent lake, several agricultural fields and pastures, five shelterbelts, and a tract of wooded river bottomland. The surveys were made on foot in one shelterbelt and in the bottomland; the others were made from a car.

Statistical Methods

Seasonal variation in the composition of the losses was analyzed with chi-square tests of independence on the families and on the 26 most frequently killed species. Kendall's Tau (Conover 1971, Ghent 1972) was employed as a measure of rank correlation between the numbers of migrants seen in the field and the losses at the tower in 1972 and 1973. Due to space limitations the tabulation of the statistical test results could not be included fully in this paper, but they are available from the authors upon request.

Nomenclature

Common names of birds correspond with those in the A.O.U. Check-List, 5th edition and supplements.

Results and Discussion

Extent of Losses

From September 1971 through November 1973, 937 birds were found dead or injured at the Omega tower (Table 1). In addition, five Red Bats (*Lasiurus borealis*) were found dead, one in fall 1971 and four in fall 1972. The diversity in the composition of the losses — 102 species, 22 families, 10 orders — is notable in view of the relatively small number of individuals actually collected. The only other published data showing greater numbers of species are two long-term studies. Stoddard and Norris (1967) and Crawford (1974) made daily searches year-round at a TV tower near Tallahassee and collected about 35,000 individuals of 177 species during an 18-year period. Regular monitoring of two TV towers in Nashville produced over 17,000 birds of 110 species in 14 years (Ganier 1962, Laskey 1956-1969b).

Other studies reporting many more individuals but fewer species killed than at the Omega tower either did not include daily searches (e.g., Caldwell and Wallace 1966 — 6505 birds, 92 species) or included only spring or fall searches (e.g., Taylor and Anderson 1973 — 7782 birds, 82 species).

On the basis of the 484 birds found on sampling areas, the estimated kill for 1972 and 1973 averaged about 1075 birds per season (Table 1). The estimated seasonal losses remained fairly constant the first two seasons, but varied more thereafter. The contribution to the total estimated kill from Stratum D (183-732 m from the tower) was considerable in each season and suggests that at the Omega tower, most mortality was caused by guy wires and transmitting cables far from the central structure. The estimated mortality must be viewed with caution because the sampling intensity in Stratum D was very low. More intensive sampling in this stratum would have made the estimates more reliable.

Scavengers and Predators

The presence of various scavengers and predators was noted in the vicinity of the tower throughout the study. Raccoons (*Procyon lotor*) were the most common mammalian components, but Red Foxes (*Vulpes vulpes*), Striped Skunks (*Mephitis mephitis*), Mink (*Mustela vison*), and Badgers (*Taxidea taxus*) were also present. Avian members included Red-tailed Hawks, Marsh Hawks, Great Horned Owls, and Short-eared Owls.

To assess the impact of these scavengers and predators, a total of 296 test birds were placed out during the four seasons in 1972 and 1973. Test birds were not placed entirely at random; occasionally some were placed selectively where particularly active scavenging was suspected. Thus, losses of test birds during the first night varied with the season from 2.4 per cent in spring 1972 to 17.6 per cent in spring 1973, and averaged 7.4 per cent overall. Six of the nine test birds lost during the night in spring 1973 were taken from two gravel sampling plots in Stratum D near an active fox den. These birds were placed there specifically to test the possibility that the foxes were searching the two sampling plots regularly in their foraging activity. If these six birds are excluded, only 3 of 45 (6.7%) test birds were taken during the first night in spring 1973, and the overall average is reduced to 5.5 per cent. On the basis of these findings, we feel that daily searches kept the losses of tower-killed birds to scavengers and predators at a level that did not unduly affect the estimates of total mortality (Table 1).

The effectiveness of the 19 sampling nets in preventing losses to scavengers and predators was demonstrated by the fact that none of the 33 test birds placed in nets during the study were taken during the first night, whereas 12 of the 69 (17.4%) test birds placed on the five gravel sampling plots were taken during the same length of time.

The level of scavenging at the Omega tower was considerably less than that reported from the WCTV tower near Tallahassee (Crawford 1971) where only 10 per cent of the 157 test birds were left undisturbed after one night. Conceivably, tower-killed birds could form a substantial supplement to the diet of a scavenger or predator, especially at a site where mortality is of regular occurrence. Predator control measures may be deemed necessary in some instances if the collection of reliable data is to be assured (Crawford 1974). While it is not possible in many situations, daily monitoring of tower mortality is essential in order to keep the loss of specimens to scavengers and predators at a minimum. In addition, dead birds that are not collected soon after death deteriorate rapidly and are rendered useless in studies of fat content.

Table 1. Bird casualties and estimated mortality at the Omega tower, fall 1971 through fall 1973

Species	*Fall 1971*	*Spring 1972*	*Fall 1972*	*Spring 1973*	*Fall 1973*	*Total*
Eared Grebe			1			1
Western Grebe		2				2
Pied-billed Grebe		1		1	3	5
American Bittern			2	1		3
Mallard	1		1	2		4
Gadwall				1		1
Pintail		1	1			2
Blue-winged Teal	1		1		1	3
Northern Shoveler			1			1
Lesser Scaup		5	2			7
Ruddy Duck			1			1
Marsh Hawk			1			1
Virginia Rail		7	2	1	1	11
Sora	3	14	12	10	7	46
Yellow Rail			1			1
American Coot	1	8	13	1	3	26
Killdeer				1		1
Common Snipe			1	2		3
Pectoral Sandpiper				1		1
American Avocet				1		1
Northern Phalarope					1	1
Mourning Dove			1	1	1	3
Black-billed Cuckoo		1		1		2
Common Flicker				1	1	2
Eastern Kingbird				1	1	2
Yellow-bellied Flycatcher			1			1
Traill's Flycatcher	1		1	2	3	7
Least Flycatcher		1		2		3
Tree Swallow		1				1
Bank Swallow				1		1
Barn Swallow	1				1	2
Brown Creeper		1				1
House Wren	2	6	2	1	2	13
Long-billed Marsh Wren	2	11			1	14
Short-billed Marsh Wren	1	1			1	3
Gray Catbird		1		1	1	3
Brown Thrasher		2				2
Sage Thrasher				1		1
Hermit Thrush			1			1
Swainson's Thrush		4	4	5	2	15
Gray-cheeked Thrush		3	5	1		9
Veery		1	1			2
Golden-crowned Kinglet	1		3		4	8
Ruby-crowned Kinglet		2	3			5
Starling				2		2
Bell's Vireo		1				1
Solitary Vireo	2					2
Red-eyed Vireo	14	1	4	2	10	31
Philadelphia Vireo				1		1
Warbling Vireo	6	1	2	2	1	12
Black-and-white Warbler	1	1	3	1	1	7
Golden-winged Warbler			1			1
Tennessee Warbler	1	2	1	5	3	12
Orange-crowned Warbler	7		9	2	6	24
Yellow Warbler	15	1	19	4	21	60
Magnolia Warbler			1			1
Black-throated Blue Warbler					1	1
Yellow-rumped Warbler	2		13	1	4	20

Michigan. Caldwell and Wallace found 24 species distributed unequally by season and suggested different spring and fall migration routes as a possible explanation. In our study, this possibility was examined by rank correlations between tower losses and field observations made during the migration seasons of 1972 and 1973. All passerine species seen in the field or killed at the tower were included in the analysis. Many nonpasserine species, particularly waterfowl and shorebirds, were seen by the hundreds in the field but appeared in the kill only rarely. Thus, all nonpasserines were excluded from this analysis because it was known *a priori* that no positive correlation existed.

There was a significant ($p<0.001$) correlation between total field observations and tower losses in the spring but not in the fall. When analyses were made on vireos and warblers combined, and on fringillids, significant ($p<0.005$) correlations were obtained in both spring and fall. These results indicate that the variations in the composition of the kill reflected corresponding seasonal differences in the local abundance of certain groups of passerine migrants. These differences may have been due to different spring and fall migration routes, as suggested by Caldwell and Wallace (1966).

Several exceptions to the relationship between field counts and tower kill were evident. The Yellow and Yellow-rumped Warblers were observed in the field more often in the spring but appeared much more often in the fall kill. Species such as the American Goldfinch and Chestnut-collared Longspur, which generally migrate diurnally, were very abundant in the field but were almost totally absent from the kill. Others, such as the Mourning Warbler and Grasshopper and Lincoln's Sparrows, which are difficult to observe in the field, appeared in the kill in greater relative numbers than they were observed during field surveys.

Previous investigators have reported on the relationship between tower kills and field observations of migrants. Graber (1968) found no correlation between fall field counts and tower kills when all species were considered; however, when comparisons were limited to closely related species (e.g., *Dendroica* warblers), correlations were significant. Weise (1971), using fall mist net data instead of field observations, reported similar results. Our findings are in agreement and indicate that tower kills do provide a reliable index of the relative abundance of certain species of migrants through a given area.

The cause of certain species suffering greater mortality at towers in one season or the other probably involves a combination of factors. In addition to those discussed here, other variables such as weather, different heights of migration in spring and fall (Bellrose and Graber 1963), and interspecific differences in the effects of tower lights on migrants must also be considered.

Summary

BEGINNING IN SEPTEMBER 1971, bird mortality was monitored during five seasons of migration at the 366-m transmitting tower of the U.S. Coast Guard's Omega Navigation Station, LaMoure, North Dakota. In summary, the findings were: (1) Throughout the study, 937 birds of 102 species were found dead or injured at the site. Based on a stratified random sampling system, the average estimated seasonal mortality in 1972 and 1973 was about 1075. (2) The composition of the losses varied seasonally — warblers and vireos dominating the fall kills and wrens, icterids and fringillids the spring kills. Birds displaying greater spring than fall losses were primarily species that breed abundantly in southeastern North Dakota. (3) Rank correlation analysis showed that the abundance in the field of vireos and warblers and of fringillids was correlated positively with their occurrence in the tower kill in both spring and fall.

Acknowledgements

We thank Douglas Johnson, John Lokemoen, and Robert Stewart of the Northern Prairie Wildlife Research Center for their assistance in the field and in the identification of the tower casualties. Advice on statistical treatment of the data was provided by Robert Carlson, Department of Entomology, North Dakota State University, and by Douglas Johnson, who was also instrumental in the development of the stratified random sampling system. The superior logistical support of the maintenance crew of the Northern Prairie Wildlife Research Center is gratefully ac-

knowledged. The willing cooperation of personnel of the U.S. Coast Guard's Omega Navigation Station throughout the study greatly facilitated the investigation.

Literature Cited

AVERY, M., P. F. SPRINGER, AND J. F. CASSEL. 1976. The effects of a tall tower on nocturnal bird migration — a portable ceilometer study. *Auk* 93:281-291.

———. 1977. Weather influences on nocturnal bird mortality at a North Dakota tower. *Wilson Bull.* 89:291-299.

BELLROSE, F. C., AND R. R. GRABER. 1963. A radar study of the flight directions of nocturnal migrants. *Proc. Int. Ornithol. Cong.* 13:362-389.

CALDWELL, L. D., AND G. J. WALLACE. 1966. Collections of migrating birds at Michigan television towers. *Jack-Pine Warbler* 44:117123.

CONOVER, W. J. 1971. Practical nonparametric statistics. John Wiley and Sons, Inc., New York. 462 pp.

CRAWFORD, R. L. 1971. Predation on birds killed at TV tower. *Oriole* 36:33-35.

———. 1974. Bird casualties at a Leon County, Florida TV tower: October 1966 — September 1973. *Tall Timbers Res. Sta. Bull.* No. 18. 27pp.

GANIER, A. F. 1962. Bird casualties at a Nashville TV tower. *Migrant* 33:58-60.

GHENT, A. W. 1972. A graphic computation procedure for Kendall's tau suited to extensive species-density comparisons. *Amer. Midl. Nat.* 87:459-471.

GRABER, R. R. 1968. Nocturnal bird migration. *Migrant* 27:66-67.

LASKEY, A. R. 1956. Television towers and nocturnal bird migration. *Migrant* 27:66-67.

———. 1957. Television tower casualties — Nashville. *Migrant* 28:54-56.

———. 1960. Bird migration casualties and weather conditions, autumns 1958–1959–1960. *Migrant* 31:61-65.

———. 1962. Migration data from television tower casualties at Nashville. *Migrant* 33:7-8.

———. 1963a. Casualties at WSIX TV tower in autumn, 1962. *Migrant* 34:15.

———. 1963b. Mortality of night migrants at Nashville TV towers, 1963. *Migrant* 34:65-66.

———. 1964. Data from the Nashville T.V. tower casualties autumn 1964. *Migrant* 35:95-96.

———. 1965. Autumn 1965 TV tower casualties at Nashville. *Migrant* 36:80-81.

———. 1966. T.V. tower casualties at Nashville, spring and fall, 1966. *Migrant* 37:61-62.

———. 1968. Television tower casualties at Nashville, autumn 1967. *Migrant* 39:25-26.

———. 1969a. T.V. tower casualties at Nashville in autumn 1968. *Migrant* 40:25-27.

———. 1969b. Autumn 1969 T.V. tower casualties at Nashville. *Migrant* 40:79-80.

STEWART, R. E. 1975. Breeding birds of North Dakota. Tri-college Center for Environmental Studies, Fargo. 295 pp.

STODDARD, H. L., AND R. A. NORRIS. 1967. Bird casualties at a Leon County, Florida TV tower: an eleven-year study. *Tall Timbers Res. Sta. Bull.* No. 8. 194 pp.

TAYLOR, W. K., AND B. H. ANDERSON. 1973. Nocturnal migrants killed at a central Florida TV tower, autumns 1969 – 1971. *Wilson Bull.* 85:42-51.

TORDOFF, H. B., AND R. M. MENGEL. 1956. Studies of birds killed in nocturnal migration. *Univ. Kansas Publ. Mus. Nat. Hist.* 10:1-44.

WEISE, C. M. 1971. Relative abundance of small landbirds in south-eastern Wisconsin. *Passenger Pigeon* 33:173-188.

—Department of Zoology, North Dakota State University, Fargo, North Dakota 58102 (first and third authors) and Northern Prairie Wildlife Research Center, Jamestown, North Dakota 58401 (present address of first author: National Power Plant Team, 2929 Plymouth Road, Ann Arbor, Michigan 48105; present address of second author: U.S. Fish and Wildlife Service, Humboldt State University, Arcata, California 95521).

Avian Mortality at Man-Made Structures: An Annotated Bibliography by Michael Avery, Paul F. Springer, and Nancy S. Dailey, contains 853 entries directly concerned with bird losses at man-made structures, primarily taken from U.S. journals and periodicals, *American Birds* being the greatest source of citations (230). These were mostly contained in regional reports and contained number of individuals and species killed during spring and autumn migrations, or migration records obtained from kill incidents with otherwise few details. This is a publication of the Biological Services Program and is available from the office of the Superintendent of Documents, U.S. Govenment Printing Office.

WEATHER INFLUENCES ON NOCTURNAL BIRD MORTALITY AT A NORTH DAKOTA TOWER

MICHAEL AVERY, PAUL F. SPRINGER, AND J. FRANK CASSEL

Made in United States of America
Reprinted from THE WILSON BULLETIN
Vol. 89, No. 2 June 1977

WEATHER INFLUENCES ON NOCTURNAL BIRD MORTALITY AT A NORTH DAKOTA TOWER

MICHAEL AVERY, PAUL F. SPRINGER, AND J. FRANK CASSEL

Most studies of bird losses at towers have dealt with weather conditions in a general manner (e.g. Tordoff and Mengel 1956, Kemper 1959, Taylor and Anderson 1973) because losses usually were not monitored on a daily basis throughout the entire migration season. Thus, weather conditions prevailing on nights of large, spectacular kills have received the most attention. Such nights are usually characterized by overcast skies, often with precipitation, winds favorable for migration, and in the fall the passage of cold fronts (e.g. Brewer and Ellis 1958).

In the course of a study of bird migration and mortality at the U.S. Coast Guard's Omega Navigation Station, located approximately 3 km west of LaMoure, North Dakota in the James River Valley (Avery et al. 1975), it was apparent that while occasional large kills occurred on overcast nights, considerable losses took place throughout the migration seasons under non-overcast skies, particularly in the spring. Since mortality was monitored daily and accurate weather data were available from nearby, it was possible to analyze the losses with respect to cloud cover and wind conditions during the entire migration seasons.

METHODS

The 366-m Omega tower is supported by 3 sets of 5 guy wires (34.9-60.3 mm diameter) spaced 120° apart. The guy wires are attached at heights of 53, 109, 167, 228, and 293 m. The lower 2 guys are anchored 122 m from the tower, the next 2 at a distance of 213 m, and the last at 297 m. In addition, 16 evenly spaced transmitting cables (50.8 mm diam.) extend from the top of the tower to a circular perimeter road 732 m away.

Searches for tower casualties were made every morning at daybreak (except for 7 days) during the study periods: 30 March-4 June and 8 August-15 November 1972 and 2 April-2 June and 12 August-3 November 1973. Because the size of the tower site and the dense vegetation on it made it difficult to find all bird casualties, the area under the guy wires (approximately 168 ha) was divided into 4 concentric strata (Avery et al. 1975): A, 0-46 m (0.66 ha) from the tower; B, 47-92 m (1.97 ha); C, 93-183 m (7.88 ha); and D, 184-732 m (157.61 ha). During the daily searches, stratum A was checked completely. The approximate areas searched in the other strata were: B—0.37 ha (18.8%), C—0.50 ha (6.3%), and D—1.51 ha (1.0%). The location and condition of each bird were recorded as it was collected, and only specimens judged to have died during the previous night were included in the analyses presented here, unless stated otherwise.

Because official weather data are not available from LaMoure, hourly weather reports were obtained from the Federal Aviation Administration Flight Service Station at Jamestown, 72 km north-northwest of LaMoure. A few of the records were discarded in and vertently by the station prior to analysis; thus, cloud cover and wind data are not available for these nights. Each of the 225 nights for which we have records of cloud cover was characterized as overcast or non-overcast. Four classes of cloud cover are recognized in the official weather reports: < 0.1 sky cover, 0.1 to < 0.6, 0.6 to 0.9, and > 0.9. These were assigned the numbers 0, 1, 2, and 3, respectively, and the 13 hourly figures from 1800–0600 CST were summed. The mean was calculated and a night was designated overcast if the mean was ≥ 2.5. All other nights were called non-overcast. This distinction is somewhat arbitrary and, conceivably, if different criteria were used, slightly different interpretations of the data would result. Wind direction and estimates of cloud cover made at the Omega tower corresponded well with the official weather reports from Jamestown.

The mean, nightly, surface wind direction was calculated from the hourly records; and the mean directions were grouped into four 90° sectors. Nocturnal bird migration in this region is primarily along a northwest-southeast axis (Richardson and Gunn 1971, Avery et al. 1976), and in this paper winds are referred to as favorable if from the 105°–195° quadrant on spring nights and 285°–015° on fall nights.

Losses in the 3 most frequently killed families, Rallidae, Parulidae, and Fringillidae, were examined during their respective periods of peak migration as indicated by field surveys conducted several times weekly near the tower site. Only the losses on nights within each of these peak migration periods were used in these analyses. Chi-square goodness-of-fit tests were used to determine if, within each family, the losses occurring during the entire peak periods in each cloud-wind category were in the same proportions as the number of nights in those categories. The G-test (Sokal and Rohlf 1969) was used to ascertain independence between cloud cover and distance of kill from the tower (Table 4) and between cloud cover and season (Table 5). Prior to analysis, the data used in Tables 4 and 5 were corrected for differences in the area searched in each stratum. In all tests $p \leq 0.05$ was accepted as statistically significant.

RESULTS AND DISCUSSION

The 5, largest, single-night kills and the accompanying weather conditions are listed in Table 1. All occurred under an overcast sky with the exception of the night of 14–15 May 1972 which was moonless and clear. Weather data revealed no conditions of overcast or poor visibility anywhere in the region that night. The behavior of birds at the tower during the kills on overcast nights was generally similar to that described by previous authors (e.g. Cochran and Graber 1958) and is treated in more detail in another paper (Avery et al. 1976).

Although the largest collections of dead and injured birds were made following overcast nights, mortality occurred consistently on clear nights as well. Table 2 shows that during spring migration the percent of losses of rails and fringillids occurring on overcast nights was about the same as the rate of occurrence of those nights; however, spring mortality in warblers and fall mortality among all 3 families occurred on overcast nights in greater-than-expected percentages ($p \leq 0.05$).

During their peak periods of spring migration, rails and fringillids were

TABLE 1

THE 5 LARGEST SINGLE-NIGHT LOSSES AT THE OMEGA TOWER IN 1972 AND 1973

Night of kill	Birds found	Weather conditions during night
25-26 Sept. 1973	69	overcast, light rain, light ENE wind
4-5 Oct. 1972	48	overcast, NE wind 5-15 k
14-15 May 1972	27	clear, light S wind
10-11 May 1972	25	overcast, drizzle, light S wind
21-22 Aug. 1972	23	overcast, NW wind 10-15 k

killed in significantly greater numbers on non-overcast nights with southeasterly winds than on nights with other conditions (Table 3). Conversely, warblers were killed in significantly greater numbers on overcast nights. In the fall, losses at night during peak migration periods under the various conditions of cloud cover and wind direction were distributed in about the same frequency as the occurrence of nights with these conditions except for warblers and fringillids which were killed in significantly greater numbers on overcast nights with northeasterly winds.

The high proportion of fall losses on overcast nights within 12 h after the passage of a cold front is consistent with other published reports (Brewer and Ellis 1958, Tordoff and Mengel 1956, Laskey 1960, Taylor and Anderson 1973). The fall losses presented in Tables 2 and 3 were due primarily to the few, large, single-night kills (Table 1), each of which was preceded by a cold front through the LaMoure area.

TABLE 2

PERCENT OF LOSSES OCCURRING ON OVERCAST NIGHTS AT THE OMEGA TOWER IN 1972 AND 1973

Family or group	Spring[1] (%)	Number of birds	Fall (%)	Number of birds
Rallidae	35	34	41*	22
Other non-passerines	36	11	50	10
Parulidae	64*	44	81*	135
Fringillidae	32	104	64*	100
Other passerines	48	57	70	46
Total	42	250	70	313
Percent of overcast nights	32		22	

[1] * Indicates statistical significance between % of loss and % overcast nights.

TABLE 3

PERCENT LOSSES IN RELATION TO CLOUD COVER AND WIND DIRECTION AT THE OMEGA TOWER IN THE PEAK MIGRATION PERIODS IN 1972 AND 1973

Family	Cloud cover[1]	Surface wind quadrant[2] NW 286–015°	NE 016–105°	SE 106–195°	SW 196–285°	No. of birds and (nights)
Spring						
Rallidae	o	20(27)[3]	40(39)	40(23)	0(12)	5(26)
	n	29(42)	12(16)	53(24)*	6(18)	17(55)
Parulidae	o	32(15)	0(23)	59(54)*	9(8)	22(13)
	n	20(47)	0(14)	50(25)	30(14)	10(36)
Fringillidae	o	21(15)	21(35)	57(40)	0(10)	28(20)
	n	3(43)	16(18)	68(27)*	13(12)	62(49)
Fall						
Rallidae	o	33(38)	67(31)	0(13)	0(19)	3(16)
	n	11(24)	11(20)	33(26)	44(30)	9(66)
Parulidae	o	23(12)	70(50)*	3(13)	4(25)	69(8)
	n	37(23)	21(27)	16(17)	26(33)	19(30)
Fringillidae	o	2(24)	91(24)*	2(29)	6(24)	54(17)
	n	20(24)	5(10)	10(27)	65(39)	20(41)

[1] o = overcast, n = non-overcast.
[2] * Indicates statistical significance between % of loss and % of nights with indicated weather conditions.
[3] % of nights in each wind category are in parentheses.

Spring losses were not characterized by large kills but were smaller and more evenly distributed throughout the season. There was no direct association of spring losses with frontal movements; the bulk of the losses occurred on nights with favorable (i.e. southeasterly) winds. Ceilometer observations made at the tower revealed that the bulk of spring migration took place on nights with southeasterly winds.

The percent of losses of birds recovered within various distances of the tower varied with cloud cover (Table 4). In each family or group the percent killed in stratum A on overcast nights was similar to that on non-overcast nights. Among rails and other non-passerines, the losses on non-overcast nights were distributed approximately evenly among the 4 strata. Losses to passerines on non-overcast nights consistently exceeded those on overcast nights in strata C and D. In each family or group, losses on non-overcast nights in stratum D were 3 or 4 times those on overcast nights. Non-passerines suffered substantially greater losses in the outermost stratum than did passerines, particularly on non-overcast nights. Overall, losses on overcast nights were concentrated near the tower in strata A and B, whereas losses on non-overcast nights were more evenly distributed, 9% occurring at least 184 m

TABLE 4
PERCENT OF LOSSES BY STRATUM AT THE OMEGA TOWER ON OVERCAST AND NON-OVERCAST NIGHTS IN THE 1972 AND 1973 MIGRATION SEASONS

Family or group[1]	Cloud cover[2]	Percent by stratum A	B	C	D	Number of birds
Rallidae	o	23	36	36	5	21
	n	22	28	28	22	35
Other non-passerines	o	43	21	29	7	9
	n	31	19	25	25	12
Parulidae*	o	44	43	13	1	137
	n	50	20	26	4	42
Fringillidae*	o	29	46	23	2	97
	n	30	35	28	8	107
Other passerines	o	34	38	27	2	59
	n	25	41	28	6	44
All birds*	o	36	42	20	2	323
	n	31	32	27	9	240

[1] * Indicates statistical significance between overcast and non-overcast nights.
[2] o = overcast, n = non-overcast.

from the tower. Within warblers, finches, and total birds, the distribution of kill by strata on overcast nights differed significantly from that on non-overcast nights.

Table 5 shows how the distance of kills from the tower varied with cloud cover and season. In both spring and fall, greater percentages of the seasonal losses were generally found in the 2 innermost strata under overcast conditions than under non-overcast. Conversely, in strata C and D, relatively more birds were found dead following non-overcast nights in both spring and fall than following overcast nights. When mortality between seasons is compared, spring losses were generally less than fall losses in strata A and B but exceeded the fall losses in strata C and D on both overcast and non-overcast nights. In both spring and fall, the differences in mortality between overcast and non-overcast nights within the strata were statistically significant and indicate that the distance of losses from the tower was influenced by cloud cover.

The differences in location of tower casualties in spring and fall is depicted in Fig. 1. This graph includes all of the tower casualties found in 1972 and 1973 and consists of raw data uncorrected for differences in areas searched. It shows that in each year the percent of fall losses exceeded those of spring within 92 m of the tower. Beyond 92 m the situation was reversed,

TABLE 5
PERCENT OF LOSSES BY STRATUM AT THE OMEGA TOWER ON OVERCAST AND NON-OVERCAST NIGHTS IN 1972 AND 1973

Season[1]	Cloud cover[2]	Percent by stratum				Number of birds
		A	B	C	D	
Spring*	o	34	34	28	4	104
	n	26	32	30	12	146
Fall*	o	37	45	17	1	219
	n	40	31	23	6	94

[1] * Indicates statistical significance in % of losses by strata between overcast and non-overcast nights.
[2] o = overcast, n = non-overcast.

except for the 184–229 m interval in 1972. These results, although not statistically significant in 1973, show that, except for this one exception, larger spring losses consistently occurred at greater distances from the tower than did fall losses.

Cloud conditions seem to have a considerable effect on the manner in which bird mortality actually occurs at the Omega tower. From the results obtained it appears that most fall mortality takes place when large numbers of birds are aloft on overcast nights. Such nights are usually closely associated with the passage of a cold front. On overcast nights, migrants congregate around the tower (Avery et al. 1976) and are killed near the structure by colliding with it, the guy wires and transmitting cables, or other birds. On the other hand, spring migrants are apparently aloft when winds are favorable, regardless of cloud cover (Table 3), and thus much mortality occurs on non-overcast nights when migrants are not congregated at the tower. On such nights, migrants actually seem to avoid the structure (Avery et al. 1976). Consequently, in the spring, sizable losses occur on non-overcast nights far from the central structure through collisions with outlying guy wires and the transmitting cables.

The regular occurrence of substantial bird losses on non-overcast nights is perhaps peculiar to the Omega tower with its widespread system of cables. Losses do occur on non-overcast nights at other towers with less extensive cable arrays (e.g. Stoddard and Norris 1967), but apparently they are not as great as at the Omega tower. Birds deviating from their flight path to avoid most towers may remove themselves from the danger of the supporting guy wires. The 16 transmitting cables extending from the top of the Omega tower, however, pose additional problems; and birds avoiding the tower, and hence the innermost supporting guy wires, are still liable to collide with the outer transmitting cables.

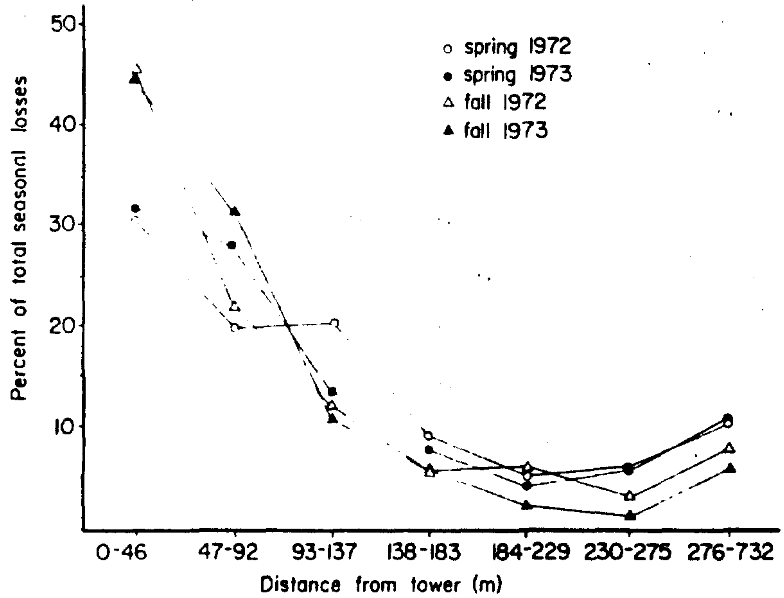

FIG. 1. The % of total seasonal losses collected at 46-m intervals from the Omega tower in 1972 and 1973.

Some of the differences in mortality among groups of migrants may be due to interspecific (or interfamilial) behavioral differences. For instance, at the Omega tower, warblers were prone to be killed close to the central structure (Table 4). Possibly warblers are influenced by red tower lights more so than are other groups, or perhaps warblers are less able to change direction to avoid inner guy wires than are other migrants. The sizable proportions of some kinds of non-passerines killed away from the tower, especially on non-overcast nights (Table 4), suggests behavioral differences that may be even more basic than family or group-level differences.

Overing (1936, 1937) also noted differences in the responses of various passerines to tall, lighted structures. On 20 October 1935, hundreds of Field Sparrows, *Spizella pusilla*, perched on benches at the base of the lighted Washington Monument: "None of these sparrows struck the monument that night, nor did they seem confused by the lights nor fly against the shaft, as the vireos and warblers were doing." The following fall, there was a similar occurrence. Of the 523 birds collected by Overing in the falls of 1935 and 1936, only 7 were fringillids. Further differences are suggested by Stoddard and Norris (1967) who noticed that during nights of heavy rainfall, fringillids tended to persist in their migratory flight while warblers, vireos, and thrushes sought ground cover.

No experimental evidence exists detailing differences among various taxa of nocturnal migrants in their response to tall, lighted structures. This area warrants more attention because conceivably such an investigation could lead to methods whereby losses of some species at towers can be reduced.

SUMMARY

An examination of the cloud cover and wind conditions that accompanied bird losses at a 366-m tower in southeastern North Dakota revealed that most fall losses occurred under overcast skies associated with the passage of cold fronts. In the spring, 58% of the mortality took place on non-overcast nights, generally with southeasterly winds. Rails were killed in relatively equal proportions on overcast and non-overcast nights in both spring and fall. Warblers were killed in significantly greater numbers on overcast nights in both seasons, as were fringillids in the fall. Losses on non-overcast nights tended to be distributed farther from the tower than were those on overcast nights. Fall losses were concentrated closer to the tower than were spring losses because fall losses occurred mostly under overcast skies as migrants milled about the tower. Spring losses seemed to occur primarily on non-overcast nights through collisions with outlying guy wires and the transmitting cables. Behavioral differences among species or families of migrants may be involved in migrant mortality at towers.

ACKNOWLEDGMENTS

This study was sponsored by the Northern Prairie Wildlife Research Center, Jamestown, North Dakota in cooperation with the Department of Zoology, North Dakota State University. The statistical advice provided by Robert Carlson and Douglas H. Johnson and the editorial review by Harrison B. Tordoff and W. Wilson Baker is greatly appreciated. Willing cooperation was provided by the U.S. Coast Guard's Omega Navigation Station. This paper is a portion of the master's thesis of the senior author.

LITERATURE CITED

AVERY, M. L., P. F. SPRINGER, AND J. F. CASSEL. 1975. Progress report on bird losses at the Omega tower, southeastern North Dakota. Proc. N.D. Acad. Sci. 27:40–49.

———, ———, AND ———. 1976. The effects of a tall tower on nocturnal bird migration—a portable ceilometer study. Auk 93:281-291.

BREWER, R. AND J. A. ELLIS. 1958. An analysis of migrating birds killed at a television tower in east-central Illinois, September 1955–May 1957. Auk 75:400–414.

COCHRAN, W. W. AND R. R. GRABER. 1958. An attraction of nocturnal migrants by lights on a television tower. Wilson Bull. 70:378–380.

KEMPER, C. A. 1959. More TV tower destruction... Passenger Pigeon 21:135–142.

LASKEY, A. R. 1960. Bird migration casualties and weather conditions, autumns 1958-1959–1960. Migrant 31:61–65.

OVERING, R. 1936. The 1935 fall migration at the Washington Monument. Wilson Bull. 48:222-224.

———. 1937. The 1936 fall migration at the Washington Monument. Wilson Bull. 49: 118-119.

RICHARDSON, W. J. AND W. W. H. GUNN. 1971. Radar observations of bird movements in east-central Alberta. *In* Studies of bird hazards to aircraft. Can. Wildl. Serv. Rept. Ser. 14:35-68.

SOKAL, R. R. AND F. J. ROHLF. 1969. Biometry. W. H. Freeman and Co., San Francisco.

STODDARD, H. L. AND R. A. NORRIS. 1967. Bird casualties at a Leon County, Florida TV tower: an eleven-year study. Tall Timbers Res. Sta. Bull. 8.

TAYLOR, W. K. AND B. H. ANDERSON. 1973. Nocturnal migrants killed at a central Florida TV tower; autumns 1969-1971. Wilson Bull. 85:42-51.

TORDOFF, H. B. AND R. M. MENGEL. 1956. Studies of birds killed in nocturnal migration. Univ. Kansas Publ. Mus. Nat. Hist. 10:1-44.

DEPT. OF ZOOLOGY, NORTH DAKOTA STATE UNIV., FARGO 58102 (MA AND JFC) AND NORTHERN PRAIRIE WILDLIFE RESEARCH CENTER, JAMESTOWN, ND 58401 (PRESENT ADDRESS MA: 231 GIBSON ROAD, ANNAPOLIS, MD 21401; PRESENT ADDRESS PFS: U. S. FISH AND WILDLIFE SERVICE, C/O HUMBOLDT STATE UNIV., ARCATA, CA 95521). ACCEPTED 3 NOV. 1976.

Regina and Lumsden TV Tower Bird Mortalities, 1964

by Fred W. Lahrman, Saskatchewan Museum of Natural History, Regina

Between August 20 and September 4, 1964, six visits were paid to the TV towers at Regina and two visits to the TV tower at Lumsden. On two of these occasions (August 21, September 4), mass kills were noted at both locations. The results of the visits are recorded below.

August 20—Checked Regina CKCK TV tower; found seven birds only—Starling (2), Red-eyed Vireo (1), Yellow Warbler (2), Red-winged Blackbird (1), Common Grackle (1).

August 21—On the drizzling wet morning of August 21, I went first to the Regina CKCK TV tower to check for birds which might have collided with the tower and the guy wires. As soon as I arrived, I noticed a number of dead birds lying on the pavement of the driveway and parking lot. Hastily picking these up as a number had already been crushed by traffic, I soon had 30 birds collected. Then a call to the Museum brought H. Beck, R. Carson and A. Swanston out to help and together we collected 127 birds at the CKCK tower, 36 birds at the CHRE tower (approximately two miles north of the CKCK tower), and 34 birds at the Lumsden tower. Table 1 shows the species recovered on August 21.

Table 1—Birds recovered at TV towers at Regina and Lumsden, August 21, 1964

Species	CKCK	CHRE	Lumsden	Total
Sora	1	1	2	4
Yellow Rail	—	—	1	1
Eastern Kingbird	—	1	—	1
Traill's Flycatcher	10	4	1	15
Least Flycatcher	2	—	1	3
Swainson's Thrush	1	—	1	2
Red-eyed Vireo	14	12	7	33
Philadelphia Vireo	1	—	—	1
Black-and-white Warbler	3	2	1	6
Tennessee Warbler	4	—	2	6
Yellow Warbler	36	6	6	48
Ovenbird	2	—	—	2
Northern Waterthrush	6	4	2	12
Mourning Warbler	17	1	7	25
Wilson's Warbler	12	3	1	16
Canada Warbler	8	1	1	10
Red-winged Blackbird	—	—	1	1
Baltimore Oriole	8	1	—	9
Clay-colored Sparrow	2	—	—	2
Total	127	36	34	197

The Regina weather office reported that during the night of August 21 when the kill apparently took place a low pressure area was moving o[ver]. The temperature held steady from 5[?] to 59° and the wind was northerly, 8 m.p.h. There was a light drizzling rain during the night and a low cloud ceiling which varied from 500 feet to below 400 feet, so that 200 feet of the tower was in this cloud layer.

August 22—Between 11:00 p.m. and midnight, August 21, I visited the CKCK tower and found two recently killed Yellow Warblers lying on the parking lot. I could hear an almost continuous stream of warblers chirping as they passed overhead in the darkness, and possibly some were circling because of the attraction of the lights. There was no indication of any more birds being killed, but on the following day (August 22) I found the following—Sora (1), Traill's Flycatcher (2), Yellow Warbler (4), Wilson's Warbler (1).

August 24—Checked Regina CKCK TV tower. Found Yellow Warbler (1), Northern Waterthrush (1), Wilson's Warbler (2), Clay-colored Sparrow (1).

August 29—Checked Regina CKCK TV tower. Found Yellow Warbler (1), Palm Warbler (1).

September 4—On arrival at the CKCK TV tower on the bright sunny morning of September 4 I could see no evidence of any birds having been killed as there were none lying dead on the parking lot. On rounding the corner of the building I was surprised to see a great number of dead birds which had been gathered into a pile. Then I saw Dave Sigelkow picking up some more. I had met Mr. Sigelkow once previously when checking the tower for birds while he was working there and I told him about the kill which had taken place on August 21. He is very interested because his business is building towers and he had no idea that they cause such mortalities. He said that when he had arrived the parking lot was littered with dead birds and that he had gath-

Lumsden TV Tower Bird Mortalities, 1964

. Saskatchewan Museum of Natural History, Regina

...d September ... paid to the ...d two visits ...den. On two ...ust 21. Sep- ...re noted at ...ults of the

...gina CKCK ...irds only— ...eo (1). Yel- ...ged Black- (1).

...zzling wet ...ent first to ...r to check ...e collided ... wires. As a number ... pavement ...rking lot. a number ... traffic. I ... Then a H. Beck, ...n out to ...cted 127 ... birds at ...tely two ...ver), and ...r. Table ...ered on

towers at ..., 1964.	
...den	Total
2	4
1	1
-	1
1	15
1	3
1	2
1	33
	1
	6
	6
	48
	2
	12
	25
	16
	10
	1
	9
	2
	197

The Regina weather office reported that during the night of August 2... 21 when the kill apparently took place a low pressure area was moving e... The temperature held steady from 5... to 59° and the wind was northerly ... 8 m.p.h. There was a light drizzle... rain during the night and a low clo... ceiling which varied from 500 feet t... below 400 feet, so that 200 feet of th... tower was in this cloud layer.

August 22—Between 11:00 p.m. and midnight, August 21, I visited th... CKCK tower and found two recent... killed Yellow Warblers lying on th... parking lot. I could hear an almos... continuous stream of warblers chirp... ing as they passed overhead in the darkness, and possibly some were circling because of the attraction of the lights. There was no indication of any more birds being killed, but on the following day (August 22) I found the following—Sora (1), Traill's Fly... catcher (2), Yellow Warbler (4), Wil... son's Warbler (1).

August 24—Checked Regina CKCK TV tower. Found Yellow Warbler (1)... Northern Waterthrush (1), Wilson's Warbler (2), Clay-colored Sparrow (...

August 29—Checked Regina CKCK TV tower. Found Yellow Warbler (... Palm Warbler (1).

September 4—On arrival at the CKCK TV tower on the bright sunn... morning of September 4 I could ... no evidence of any birds having be... killed as there were none lying dea... on the parking lot. On rounding t... corner of the building I was surpri... to see a great number of dead bir... which had been gathered into a p... Then I saw D... S... kow p... up some more. I had m... Mr. S... kow once previously when ... the tower for birds wh... he w... working there and told him about th... kill which had taken place on Augu... 21. He is very interested because h... business is building towers and h... had no idea that they cause such mor... talities. He said that when he had arrived the parking lot was littered with dead birds and that he had gath...

...d them up so they would not be ...maged by the traffic. Beck, Carson ...d I gathered many more in the sur...unding grassy areas and stubble ...lds. The majority of the birds were ...und south and east of the tower. A ...tal of 216 birds of 28 species was ...und at the CKCK tower and 77 birds ... 18 species at the CHRE tower. A ...nsiderable number of injured birds ...re flushed from the ground. Most ...f these were able to fly away. Among ...ese were noted a Catbird, Red-eyed ...ireos, Northern Waterthrushes, Oven...birds, Swamp Sparrows, and other ...arblers and sparrows. The Lumsden ...wer was also checked but no birds ...ere found there. Table 2 shows the species recovered on September 4.

The Regina weather office reported ...at during the night when the kill ...ook place the temperature held at ...0°, the wind was NW at 20 m.p.h., ...arometric pressure steady at 951.8. There was a cloud layer at 4,000 feet, and a complete cloud layer at 8,000 feet all night. No rain fell.

Table 2—Birds recovered at TV towers Regina, September 4, 1964.

Species	CKCK	CHRE	Total
Virginia Rail	1	—	1
Sora	1	1	2
Traill's Flycatcher	2	—	2
Barn Swallow	—	1	1
Swainson's Thrush	1	6	7
Gray-cheeked Thrush	—	1	1
Solitary Vireo	1	—	1
Red-eyed Vireo	30	9	39
Philadelphia Vireo	2	1	3
Warbling Vireo	1	1	2
Black-and-white Warbler	3	1	4
Tennessee Warbler	32	6	38
Yellow Warbler	39	12	5[illegible]
Magnolia Warbler	1	—	1
Bay-breasted Warbler	1	1	[illegible]
Blackpoll Warbler	6	6	1[illegible]
Palm Warbler	1	—	1
Ovenbird	38	15	5[illegible]
Northern Waterthrush	7	6	1[illegible]
Mourning Warbler	14	5	1[illegible]
Yellowthroat	5	—	[illegible]
Wilson's Warbler	3	2	[illegible]
Canada Warbler	3	—	[illegible]
American Redstart	2	—	[illegible]
Red-winged Blackbird	1	—	[illegible]
Baltimore Oriole	2	—	
Savannah Sparrow	1	—	
Sharp-tailed Sparrow	1	—	
Clay-colored Sparrow	3	—	
White-throated Sparrow	—	1	
Lincoln's Sparrow	14	2	1[illegible]
Total	216	77	29[illegible]

Eared Grebe Colony at Regina, 1964

by **Fred W. Lahrman**, Saskatchewan Museum of Natural History, Regina

For four years we have been watching an Eared Grebe colony grow in numbers at the Regina Waterfowl Park. In 1961, 48 nests were counted (*Blue Jay*, 19:170-171), **in 1962 the colony had a total of 165 nests** (*Blue Jay*, 20:158) **and in 1963 a total of 179** (*Blue Jay*, 22:17). **In 1964, the highest count of Eared Grebe nests ever made in the Regina Waterfowl Park was recorded—a count of 300.**

The first Eared Grebe arrived at the Regina Waterfowl Park April 21, 1964, with an influx of Lesser Scaup being recorded on that date along with one Horned Grebe and one Pied-billed Grebe, by Margaret Belcher. By May 2 the grebes were established in numbers at the Waterfowl Park. On May 27 Dot and Doug Wade counted 32 nests scattered in small groups where water plants were available in the area south of the city power house, and on May 30 they counted 112 nests. Strong winds on June 4 washed away some of the nests, but when the Wades checked the colony on June 6 they found active rebuilding and counted 76 nests east of the power house with others under construction east of the Broad Street bridge. When I made my count on July 2, there was an impressive total of 300 nests. The heavy rain of July 3 destroyed almost ... these nests and there was little nesting after. However, many ... had already hatched and the st... did not harm these young birds.

PRAIRIE NEST RECORDS SCHEME

You are invited to keep nest records for the 1965 season and to submit them to the Prairie Nest Records Scheme. All records should be submitted on nest record cards which can be obtained from the Chairman, Robert Taylor. Those who contributed records in 1964 will receive cards automatically. But all new contributors should write for cards and further instructions about keeping records. Write

ROBERT R. TAYLOR,
Chairman, Prairie Nest Records Scheme,
Box 1121,
Regina, Sask.

Regina TV Tower Bird Mortalities—1961

by Robert W. Nero, Univ. of Sask., Regina

Two major bird mortalities involving 94 and 113 collision casualties recently occurred at the CKCK tower on No. 1 Highway, two miles east of Regina. These numbers are by no means large in comparison with TV tower mortalities which have been reported in other areas (e.g., 20,000 at a tower in Wisconsin; Kemper, 1958), but these are the largest kills reported for the Northern Plains region. Lahrman (1959) reported 33 birds of 13 species killed at a tower near Caron, Saskatchewan, about 38 miles west of Regina, about September 22, 1959, and this was considered an unusual occurrence. The CKCK tower, which is 670 feet high, had been checked several times in the past five years during migration waves and although occasionally a few dead birds had been found, no notable numbers of casualties had been observed. However, because of the number of migrants in Regina coincident with bad weather on September 2, 1961, a check seemed worthwhile.

Accordingly, in mid-morning of September 3, I drove with my family to the tower. As soon as we stopped the car in the parking lot it was evident that there had been a substantial mortality, for several birds were lying right in sight on the pavement. In about an hour and a half, with all members of the family assisting, 94 birds of 22 species were picked up in the vicinity of the tower (see table 1). Of the 22 species, 13 different kinds of warblers and three kinds of vireos were represented. Red-eyed Vireos made up 51 per cent of the total. There were 18 males and 24 females; 12 of the males and 14 of the females were immatures (as indicated by skull ossification), yielding a ratio of 38 per cent adult to 62 per cent immature. These figures indicate a fairly well-balanced population with possibly fewer adult males than normal, suggesting that some males in the population may have migrated earlier. At any rate, it seems that all members of the migrating population were equally affected by the mortality at the tower and that the total species sample was random. The preponderance of immatures in the sample (55 per cent) is of interest in view of the observations of Brewer and Ellis (1958) that adults predominate in fall kills.

Kemper (1958), in discussing a kill of 1525 birds involving 82 Red-eyed Vireos and 25 Philadelphia Vireos, notes the absence of the Warbling Vireo in his sample and raises the question of whether some species are less prone to accidents. It is curious

TABLE 1

Birds recovered at TV tower, September 3, 1961

Species	*Number*	*Age and Sex*
Sora, *Porzana carolina*	4	3 imm., 1 ad.
Least Flycatcher, *Empidonax minimus*	1	imm.
Solitary Vireo, *Vireo solitarius*	2	2 imm.
Red-eyed Vireo, *Vireo olivaceus*	48	26 imm., 16 ad.
Philadelphia Vireo, *Vireo philadelphicus*	1	?
Black-and-white Warbler, *Mniotilta varia*	3	3 ad.
Tennessee Warbler, *Vermivora peregrina*	2	1 imm., 1 ad.
Yellow Warbler, *Dendroica petechia*	10	2 imm., 8 ad.
Magnolia Warbler, *Dendroica magnolia*	1	imm. male
Myrtle Warbler, *Dendroica coronata*	1	1 imm., male
Bay-breasted Warbler, *Dendroica castanea*	3	3 imm.
Blackpoll Warbler, *Dendroica striata*	4	4 imm.
Ovenbird, *Seiurus aurocapillus*	3	1 ad., 2?
Connecticut Warbler, *Oporornis agilis*	1	1 imm., female?
Mourning Warbler, *Oporornis philadelphia*	1	imm., female
MacGillivray's Warbler, *Oporornis tolmiei*	1	1 ad., male
Yellowthroat, *Geothlypis trichas*	1	ad., female
American Redstart, *Setophaga ruticilla*	1	ad., male
Savannah Sparrow, *Passerculus sandwichensis*	1	ad.
Clay-colored Sparrow, *Spizella pallida*	2	2 ad.
Lincoln's Sparrow, *Melospiza lincolnii*	2	1 ad., 1?
Chestnut-collared Longspur, *Calcarius ornatus*	1	1 ad., male
Total	94	